Integrated Biorefinery Research Facility
Lessons Learned – Stage I Acquisition through Stage II Construction Completion
August 2011

This document contains lessons learned for the Integrated Biorefinery Research Facility (IBRF) project. The period covered by these lessons learned is IBRF's Stage I acquisition through Stage II construction completion. The lessons learned presented are specific for construction line item type projects at the National Renewable Energy Laboratory (NREL) typically with a total project cost (TPC) in excess of $20M.

Lessons Learned – IBRF-001

Lessons Learned Statement:
Incorporate a strong safety culture early and into all phases of the project, from developing the RFP through construction and commissioning.

Critical Decision Stage:
CD-0, CD-1, CD-2/3

Background Summary:

1. Construction safety during IBRF Stages I and II was excellent, in part due to the fact that the safety manager was dedicated, experienced and proactive, and management was extremely supportive.
2. Safety walks and inspections were held consistently thereby communicating to the Design-Build (D-B) team the critical importance of safety during the project.
3. A safety-conscious attitude was reinforced through the communication of clear safety expectations.
4. The D-B contractor's integrated work plan meeting was used to inform NREL construction and safety.

Improvement Action:

1. The D-B contractor should employ a dedicated, full-time Safety Manager as a single point of contact responsible for all aspects of the construction phase for projects of appropriate value.

Lessons Learned – IBRF-002

Lessons Learned Statement:
Multi-stage projects have inherent risks that cross projects and need to be considered during planning.

Critical Decision Stage:
CD-1, CD-2/3

Background Summary:

1. Due to demands on staff resources time, NREL staff was engaged in IBRF Stage I testing during Stage II.
2. Air handler unit #2 and the hot water coil froze on the lower level of IBRF during sub-zero temperatures impacting the project schedule.

Improvement Action:

1. Adequately staff multi-stage projects with distinct resources assigned to each project.
2. Risk and commissioning plans, and other planning documents, need to explicitly consider inter-project relationships of multi-stage concurrent projects.
3. Additional Stage I commissioning work may have helped eliminate the freeze issue during Stage II.

Lessons Learned – IBRF-003

Lessons Learned Statement:
Start the project risk management plan during the pre-CD-0 (project planning phase) and ensure it is comprehensive and provides sufficient management reserve and contingency to support the scope of work.

Critical Decision Stage:
CD-0, CD-1, CD-2/3

Background Summary:
As risks were retired near the end of the project and management reserve was released, the D-B subcontractors had to incorporate scope changes near the end of the project.

Improvement Action:

1. Communicate early in CD-1 with the D-B team so expectations are clear that the risk plan is based on releasing management reserve and contingency to execute more scope as project risks are retired, which means that the D-B team should be prepared for these scope changes.
2. Continually update the risk management plan throughout the project as major risks are retired.

Lesson Learned – IBRF-004

Lesson Learned Statement:
Utilize Design-Build Institute of America (DBIA) best practices to obtain competitive pricing.

Critical Decision Stage:
CD-0, CD-1

Background Summary:

1. The Project Objectives Checklist was divided into three categories – "Mission Critical", "Highly Desirable" and "If Possible". During the proposal period the three shortlisted firms bid against each other to accomplish as much of the checklist as possible within the firm fixed price budget.
2. NREL received competitive bids for the work scope.
3. All "Mission Critical", "Highly Desirable" and "If Possible" options were obtained in the proposal process.

Improvement Action:
Continue to utilize DBIA best practices to obtain competitive pricing for future design-build acquisitions.

Lesson Learned – IBRF-005

Lesson Learned Statement:
Design-build acquisitions should be planned as a 2 stage acquisition for complex one-of-a-kind projects like those associated with new research and development facilities.

Critical Decision Stage:
CD-0, CD-1, CD-2/3

Background Summary:

1. The acquisition was separated into two phases. Phase I was preliminary design and Phase II was final design and construction.
2. The winning design-build team was contracted to perform preliminary design sharing half the cost risk of this phase.
3. During preliminary design it was determined that funding was not adequate for entire project scope. The project was then divided into two Stages (Stage I – high bay and 1st process train, and Stage II – 2nd process train in Stage I high bay, office addition, and AFUF laboratory modifications).
4. Project implementation then included Stage I final design and construction, Stage II preliminary design, and Stage II final design and construction.
5. Stage I scope was able to be efficiently and effectively aligned with available funds without project delays.

6. Stage I and II process equipment scope was established by evaluation of competitive vendor proposals. Research team was able to consider cost trade-offs and select equipment most consistent with overall R&D objectives.
7. There was an opportunity to effectively balance funds utilized for high bay R&D equipment with those for office addition and lab upgrades.

Improvement Action:
Apply a 2 phase acquisition strategy to future complex projects including significant R&D equipment components, as applicable.

Lesson Learned – IBRF-006

Lesson Learned Statement:
Utilize Design-Build Institute of America (DBIA) best practices to implement an award fee incentive program.

Critical Decision Stage:
CD-0, CD-1, CD-2/3

Background Summary:
1. An award fee program was developed to incentivize the D-B team but was difficult to quantify when scoring performance.
2. The use of an award fee incentive program allows Alliance to modify the design-builder's behavior. This keeps the design-builder focused on the issues important to Alliance.
3. The use of an award fee program provides an opportunity for owner to communicate project priorities.

Improvement Action:
1. Continue to utilize DBIA best practices to implement an award fee incentive program.
2. Have the award fee board members review the award fee program and criteria to ensure the criteria are workable when it comes to scoring performance.

Lesson Learned – IBRF-007

Lesson Learned Statement:
Utilize Design-Build Institute of America (DBIA) best practices to obtain complete and appropriate proposals – Have offerors review the draft request for proposal (RFP).

Critical Decision Stage:
CD-0, CD-1

Background Summary:

1. During the proposal process, the Alliance/DOE/DSI team had each offeror review the draft RFP and comment on scope, schedule, budget and technical content.
2. Review of the draft RFP allowed the bidding community to comment on scope, schedule, budget and technical content. This allowed for a realistic assessment of the possibility of success for the RFP response.

Improvement Action:
Continue to utilize DBIA best practices and allow offerors to review and comment on the draft RFP.

Lesson Learned – IBRF-008

Lesson Learned Statement:
Utilize Design-Build Institute of America (DBIA) best practices to obtain complete and accurate proposals – Complete one-on-one meetings with offerors.

Critical Decision Stage:
CD-0, CD-1

Background Summary:

1. During the proposal process, the Alliance/DOE/DSI team had one-on-one meetings with each individual offeror.
2. Communication with offerors was established to ensure the proposals were on track to meet the project requirements.
3. Alliance/DOE received complete and accurate proposals which addressed project requirements.

Improvement Action:
Continue to utilize DBIA best practices and complete one-on-one meetings for future design-build acquisitions.

Lesson Learned – IBRF-009

Lesson Learned Statement:
DOE-OECM project review requirements need to be determined and scheduled well in advance to ensure CD-2/3 authorization is not delayed.

Critical Decision Stage:
CD-1, CD-2/3

Background Summary:

1. During Stage I an Independent Project Review (IPR) was completed in November 2008. All findings were closed out by January 14, 2009 with EERE approval of

revised Mission Needs Statement for Stage II project elements ($13.5M for 2nd process train in Stage I high bay, office addition, and AFUF laboratory modifications).
2. In February 2009, OECM notified the Federal Project Director that an External Independent Review (EIR) was required due to lack of EERE Program Management Office. The EIR review was conducted in March 2009.
3. EIR findings were addressed in updated CD-2/3 package submitted to the Federal Project Director on April 23, 2009.
4. Stage I CD-2/3 authorization was obtained and Stage I Phase II design-build subcontract modification was executed on May 15, 2009.
5. Stage I CD-2/3 authorization was approximately five months later than originally planned.

Improvement Action:
Establish project review requirements and coordinate review schedule and subsequent critical decision authorizations in support of the approved overall project schedule.

Lesson Learned – IBRF-010

Lesson Learned Statement:
Utilize Design-Build Institute of America (DBIA) best practices to obtain complete proposals – Fund stipend pools to offset offeror proposal costs.

Critical Decision Stage:
CD-0, CD-1

Background Summary:
To support the proposal process, Alliance/DOE provided a stipend pool to offset offerors costs to prepare complete proposals.

1. Alliance/DOE received complete and detailed proposals to support evaluation and selection.
2. The use of stipends initiated the partnership between Alliance/DOE and the D-B team.
3. The use of stipends provided an incentive to bidders to develop a more complete proposal package.

Improvement Action:
1. Continue to utilize DBIA best practices and fund stipends for future design-build acquisitions.
2. Obtain early buy-in from DOE when utilizing stipends.

Lessons Learned – IBRF-011

Lessons Learned Statement:
Standardize performance requirements for various aspects of the project such as commissioning, energy, security, environment, health, safety, quality, etc.

Critical Decision Stage:
CD-0, CD-1

Background Summary:

1. Much time and effort was spent to define requirements, and supporting modifications had to be made in the field.
2. OSHA machine guarding requirements were not incorporated with the fabrication of the process equipment.

Improvement Action:

1. Recommend each NREL Office develop and maintain standards to be incorporated into the NREL Design Guidelines to direct specific requirements in the RFP.
2. Recommend incorporation ESH&Q's beneficial occupancy checklist into the subcontract and punchlists.
3. Adequate time should be devoted during the project planning phase to detail performance requirements.

Lessons Learned – IBRF-012

Lessons Learned Statement:
Have a dedicated QA Subject Matter Expert (SME) actively engaged in the project to assure project quality.

Critical Decision Stage:
CD-1, CD-2/3

Background Summary:

1. Initiation of quality walks and assessments provided an opportunity not only to review the level of craftsmanship exhibited in the field with regard to the "finished product" but also established a process to ensure the D-B team was operating in accordance with their Quality Assurance Plan.
2. Quality walks facilitated collaboration between the design-build team, respective subcontractors, and Alliance representatives to discuss quality issues and observations.
3. The IBRF QA SME maintained a QA log to track and resolve quality observations and deficiencies.
4. Verified materials identified in the field were approved for use in accordance with project specifications and approved submittals.

5. The QA SME ensured required testing was performed in accordance with industry standards.
6. The QA SME verified deficiencies, documented and tracked nonconforming work to resolution, and implemented associated corrective actions to prevent reoccurrence.

Improvement Action:

1. Ensure a dedicated QA SME is assigned to all construction projects (for projects of appropriate size and budget) and is part of the IPT.
2. Continue quality walks and assessments to review various elements of design and construction to ensure the final product meets the requirement defined in the subcontract.

Lessons Learned – IBRF-013

Lessons Learned Statement:
Utilize a design-build acquisition strategy to improve schedule performance.

Critical Decision Stage:
CD-0, CD-1

Background Summary:

1. The design-build acquisition strategy allows for construction to start before the entire design is complete thereby shortening the overall project schedule.
2. The design-build acquisition allows for contract award for both design and construction early in the project life cycle.
3. The initial design-build award takes longer than the award of design for a design-bid-build project.
4. Dividing the IBRF design into different design packages streamlined the IPT review and approval process and allowed the construction to start earlier.

Improvement Action:
Continue to use a design-build acquisition strategy for projects which are schedule critical.

Lesson Learned – IBRF-014

Lesson Learned Statement:
The monthly pay application and schedule submittal deliverables provided by the design-builder helped to track project performance and contributed to a large reduction in paperwork.

Critical Decision Stage:
CD-1, CD-2/3

Background Summary:

1. All contract deliverables as specified in Article 17 of the subcontract were mainly provided in electronic format and only provided in hard copy when the final monthly invoice was due or on an exception basis (e.g., large format schedule print outs, etc.).
2. The total set of monthly deliverables was culled to three main documents; 1) the Primavera construction schedule, 2) the Schedule of Values, and 3) the monthly Cash Flow Plan.
3. The Schedule of Values was provided on the standard AIA G702/G703 forms.
4. All contract deliverables were pre-reviewed prior to the monthly pay-application meetings.
5. The monthly pay application meetings were limited to a one-hour session with a tightly controlled agenda and attendance.
6. All attendees had reviewed the advance materials and came prepared with specific questions or back-up materials to prove quantities claimed.
7. The final corrected monthly invoice was delivered in electronic format in both Adobe pdf and in the native application (Primavera for schedules and Excel for the G702/703).
8. The use of a project web site provided an efficient and effective repository and archive for the monthly pay application deliverables.
9. The use of electronic deliverables contributed to a large reduction in paperwork and allowed efficient dissemination of review materials.
10. The use of native format electronic files allowed NREL to perform independent analyses on submittals in a timely manner and to perform ad hoc inquiries.
11. The use of standard AIA G702/G703 will permit the assignment of values to DOE asset codes during project closeout vs. requiring billing by asset code which would place an extreme burden on the design-builder.
12. This pay application process received positive feedback from the DOE OECM team that audited NREL/Alliance.
13. The use of this system contributed to the NREL EVMS Certification received in February 2010 which allows future CLI projects to be completed at NREL.

Improvement Action:
Continue to require all monthly schedule and pay application deliverables as specified in Subcontract Article 17, as well as the current pay application processes, on all future CLI projects.

Lessons Learned – IBRF-015

Lessons Learned Statement:
The automated accrual system/process required modifications to accommodate the nuances of construction projects and EVMS requirements.

Critical Decision Stage:
CD-1, CD-2/3

Background Summary:

1. When new subcontracts and purchase orders were entered into the Oracle accrual system the period of performance determined the accrual schedule and the project dollars were spread evenly over the period of performance.
2. EVMS requires the project to accrue costs according to performance earned each month, which requires an update to the Oracle accrual system.
3. Incorrect accrual amounts were recorded when automatically scheduled accruals were allowed to occur.

Improvement Action:

1. Financial analysts, project control engineers, and accounting specialists need to work together to ensure that correct amounts are accrued for each construction project, subcontract, and purchase order within the project each month.
2. Reprogram the Oracle accrual system to put a ‘hold’ on all newly entered construction subcontracts and purchase orders until accruals are verified to ensure against automatic, incorrect accruals.